

Amended claims to be filed when entering the National
Phase

CLAIMS

1. A magnetic actuator including a mobile
magnetic portion (20), a fixed magnetic portion (10)
5 provided with at least two attraction areas (11, 12)
for the mobile magnetic portion (20), and means (30)
for triggering the displacement of the mobile magnetic
portion (20), the mobile magnetic portion (20) being in
levitation when it is not in contact with an attraction
10 area (11, 12), characterized in that the mobile
magnetic portion (20) includes a magnet-based part
(200) with reduced magnet weight, this part (200)
having an overall volume, and a mass which is less than
the one it would have if its overall volume was totally
15 occupied by the magnet.

2. The magnetic actuator according to claim
1, characterized in that the part (200) with reduced
magnet weight includes one or more magnets (22, 24, 26)
20 provided with at least one recess (21, 27).

3. The magnetic actuator according to claim
2, characterized in that the recess (21) is a
through-hole.

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4. The magnetic actuator according to claim
2, characterized in that the recess (21) is filled with
a solid material (25) with lesser density, less than
that of the magnet (24).

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5. The magnetic actuator according to claim
4, characterized in that the lesser density solid
material is selected from semiconducting material,
plastic material, soft magnetic material, dielectric
5 material.

6. The magnetic actuator according to claim
2, characterized in that the recess (21) is empty of
solid material.

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7. The magnetic actuator according to claim
1, characterized in that the part (200) with reduced
magnet weight is a substantially rectangular plate.

8. The magnetic actuator according to claim
1, characterized in that the part (200) with reduced
magnet weight includes a magnet frame (24).

9. The magnetic actuator according to claim
20 1, characterized in that the part (200) with reduced
magnet weight includes in the direction of the
displacement, a succession of magnets (26) spaced apart
from each other, these magnets (26) having a same
magnetization orientation.

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10. The magnetic actuator according to
claim 1, characterized in that the part (200) with
reduced magnet weight includes in the direction of the
displacement, an alternating succession of magnets (26)
30 and of at least one solid portion (27) of lesser
density.

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11. The magnetic actuator according to any
of claims 9 or 10, characterized in that the magnets
(26) are in the form of orientated bars substantially
5 normal to the displacement.

12. The magnetic actuator according to any
of claims 9 or 10, characterized in that the succession
includes a magnet (26) at each end.

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13. The magnetic actuator according to
claim 12, characterized in that the end magnets (26)
have a dimension in the direction of the displacement,
substantially equal to the displacement.

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14. The magnetic actuator according to any
of claims 9 or 10, characterized in that the means (30)
for triggering the displacement include at least one
conductor (30) arranged as a meander formed with
20 sections (30.1, 30.2) of successive conductors wherein
a current is able to flow in opposite directions, each
of the magnets (26) of the succession, when the mobile
magnetic portion (20) is stuck on the attraction area
(11, 12), cooperating with one of the sections (30.1 or
25 30.2), the current flowing in the same direction in
these sections.

15. The magnetic actuator according to
claim 1, characterized in that the part (200) with
30 reduced magnet weight includes at least one central
magnet (28) surrounded at least partially by at least

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one portion (29) of lesser density, this central magnet (28) being in the form of a substantially rounded or ovoid pad.

5 16. The magnetic actuator according to claim 1, characterized in that the mobile magnetic portion (20) includes at least one face (201a), which must come and stick on an attraction area (11, 12), this face (201a) being curved.

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 17. The magnetic actuator according to claim 1, characterized in that the mobile magnetic portion (20) includes at least one face (205) which must come and stick on an attraction area (11, 12),
15 this face being arranged as a zigzag.

 18. The magnetic actuator according to claim 1, characterized in that each attraction area (11, 12) has a geometry conjugate to that of the face
20 (201a, 205) of the mobile magnetic portion (20) which must come into contact with it.

 19. The magnetic actuator according to claim 1, characterized in that at least one of the
25 attraction areas (11) includes a dielectric portion (111) so as to achieve capacitive contact when the mobile magnetic portion (20) is stuck on said attraction area.

30 20. The magnetic actuator according to claim 1, characterized in that the part, with reduced

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magnet weight includes a dielectric portion (29) so as to achieve capacitive contact when the mobile magnetic portion (20) is stuck on one of the attraction areas (11, 12).

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21. A method for making a magnetic actuator, characterized in that it includes the following steps:

10 - on a first substrate (91, 93), making cases (51) capable of receiving magnets (3-1, 24) of a fixed magnetic portion and a part (200) with reduced magnet weight, of a mobile magnetic portion, this part (200) with reduced magnet weight having an overall volume, and a mass which is less than the one it would
15 have if its overall volume was totally occupied by the magnet,

- depositing magnets (3-1, 24) in the cases (51),

20 - depositing a dielectric layer (54) and etching the latter to expose the part (200) with reduced magnet weight of the mobile magnetic portion and its surroundings up to the fixed magnetic part,

25 - on a second substrate (92), making at least one case (55) capable of receiving a conductor for triggering a displacement of the mobile magnetic portion,

- depositing the conductor (4-1) in the case (55),

30 - assembling both substrates (91 or 93, 92) by putting them face to face,

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- totally or partially removing the first substrate (91, 93) so as to release the part (200) with reduced magnet weight from the mobile magnetic portion.

5 22. The method according to claim 21, characterized in that it includes a step for magnetizing the magnet (24) of the part (200) with reduced magnet weight of the mobile magnetic portion and possibly of the fixed magnetic portion before
10 releasing the part (200) with reduced magnet weight.

 23. The method according to claim 21, characterized in that the step for etching the dielectric layer (54) of the first substrate (91, 93)
15 also aims at providing at least an aperture (46) for accessing at least one electric contact for supplying power to the conductor (4-1).

 24. The method according to claim 23,
20 characterized in that the step for etching the dielectric layer (54) is followed by a step for etching the first substrate (91, 93) around the part (200) with reduced magnet weight and at the level of at least one portion (21) of lesser density, with which the part
25 (200) with reduced magnet weight is provided.

 25. The method according to claim 23, characterized in that the step for etching the dielectric layer (54) is followed by a step for etching
30 the first substrate (91, 93) around the part (200) with reduced magnet weight by masking at least one portion

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(21) of lesser density with which the part (200) with reduced magnet weight is provided, this portion (21) of lesser density being full of the material of the substrate.

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26. The magnetic actuator according to claim 21, characterized in that it includes a step for achieving at least one electric contact (47) for supplying power to the conductor (4-1) on the second
10 substrate (92) after depositing the conductor and before assembling both substrates (91 or 93, 92).

27. The magnetic actuator according to claim 21, characterized in that it includes a step for
15 depositing dielectric material (59) at the surface of the second substrate (92) before assembling both substrates (91 or 93, 92).

28. The magnetic actuator according to
20 claim 21, characterized in that the substrates are massive semiconducting or SOI type substrates (93).